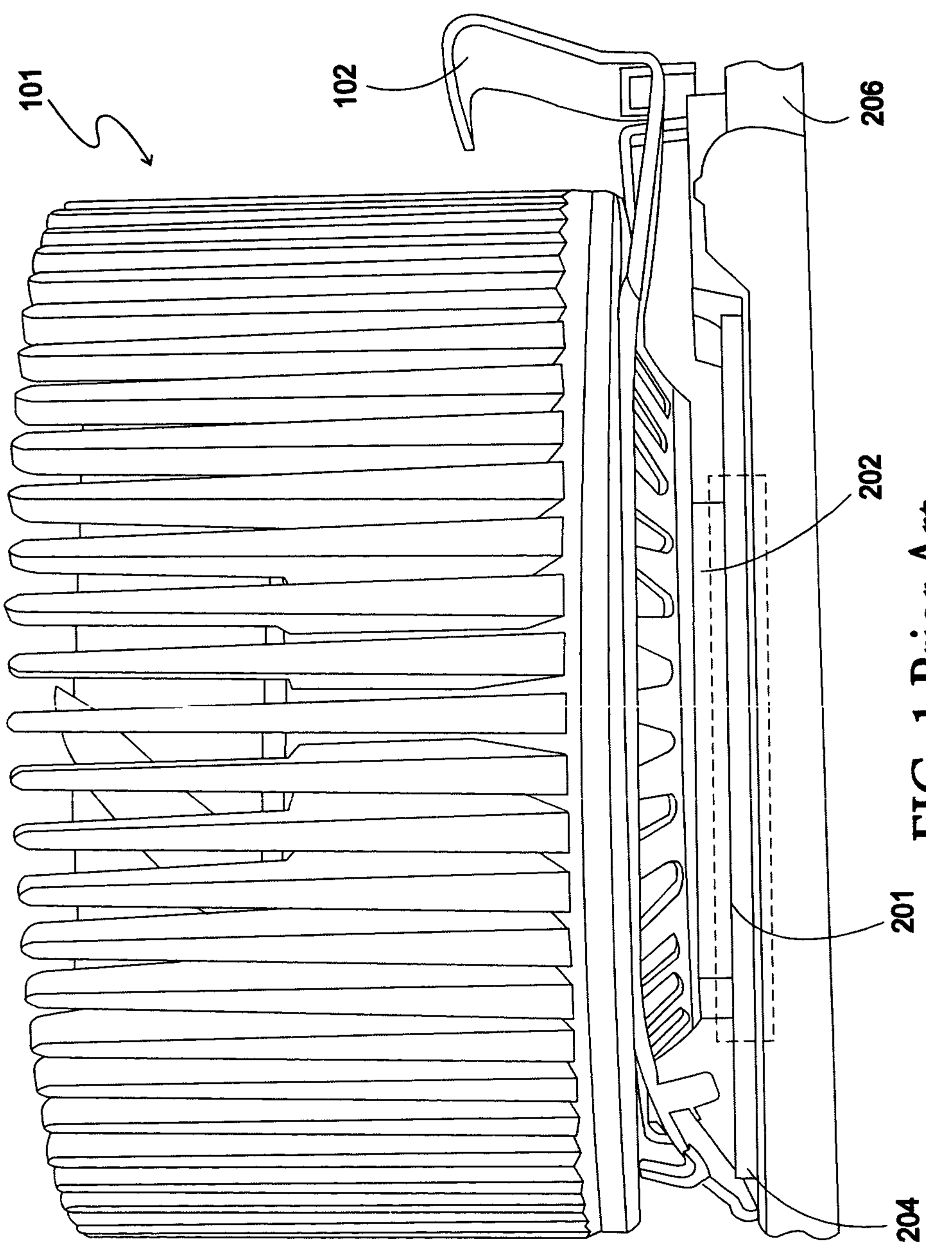

FIG. 1 Prior Art

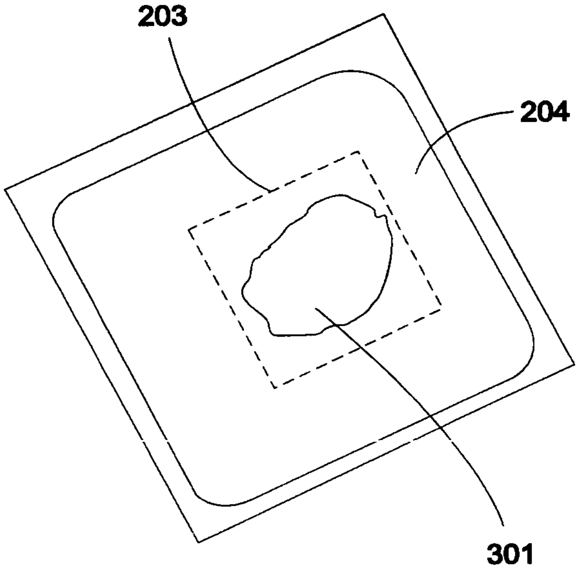

FIG. 3 Prior Art

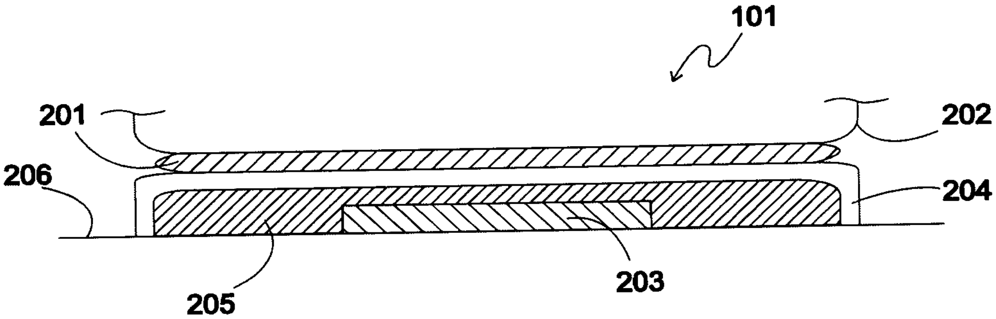

FIG. 2 Prior Art

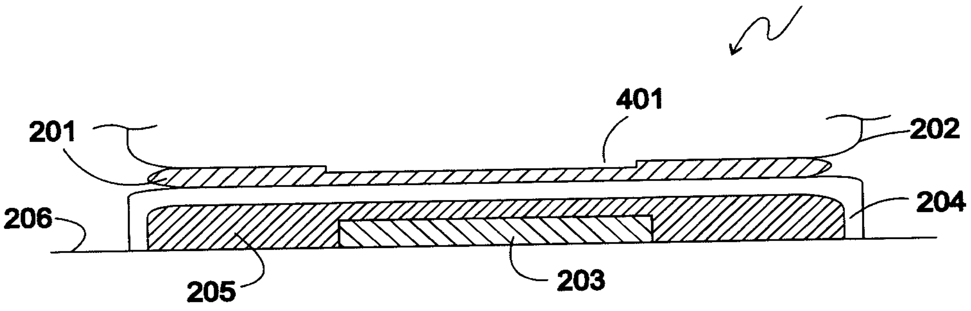

FIG. 4

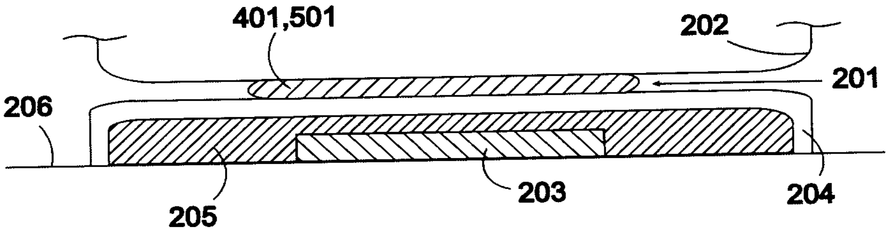

FIG. 5

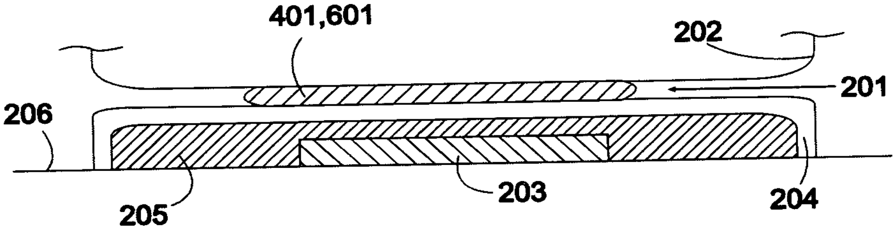

FIG. 6

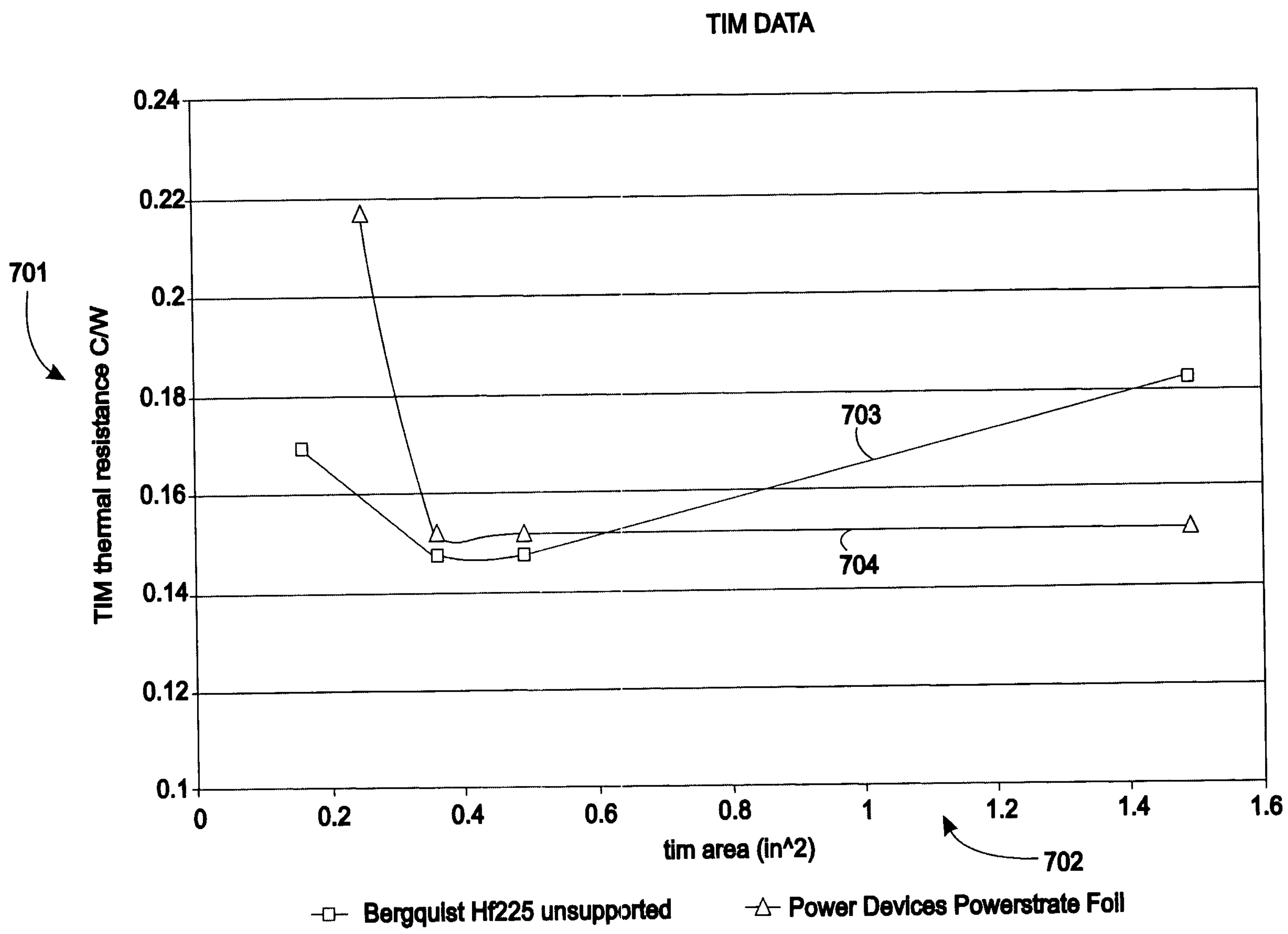
TIM DATA
701
TIM thermal resistance C/W
0.24
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
tim area (in^2)
702
703
704
Bergquist Hf225 unsupported
Power Devices Powerstrate Foil

FIG. 7

```
     {Program to Calculate Optimal initial size of TIM}

820  FUNCTIONAL Afinal(A_lid,A)                     {function to determine if
     final Area of TIM is within lid area (assures proper calculations of pressure
     on TIM)}

        if(A>A_lid) then Afinal=A_lid
        endif
        if(A=A_lid) then Afinal=A_lid
        endif
        if(A<A_lid) then Afinal=A
        endif
     end

     FUNCTION Afinal2(A_epsilon,A)                  {function to determine if
     final Area of TIM is within effective area (assures proper calculation of
     theta)}

        if(A>A_epsilon) then Afinal2=A_epsilon
        endif
        if(A=A_epsilon) then Afinal2=A_epsilon
        endif
        if(A<A_epsilon) then Afinal2=A
        endif
     end

801  A_lid=30.8*30.8*convert(mm^2,m^2)      {Area of Processor lid}

802  ti=3*convert(mil,m)                    {Initial Thickness of TIM}
     ti_micron=ti*covert(m,micron)
     {l=.4}—— 806                           {Initial length of TIM Ai=lxl in inches}
805  Ai=l^2*convert(in^2,m^2)               {Initial Area of TIM in m^2}
     Ai_in2=Ai*convert(m^2,in^2)            {Initial Area of TIM in in^2}
807  V=ti*Ai                                {Initial Volume of TIM}
803  F=20          811                      {Force on TIM in lbf (assumed constant)}
     P=F/Af_in2                             {Final Pressure on TIM in psi (note:
810  Af_in2 is Af in in^2 and Af comes from Afinal function)}
     V=t_m*A —— 809                         {Final Volume of TIM = initial volume}
          —— 808
     {TIM thickness vs. pressure and bulk conductivity data}
812  t=-6.0989*ln(P)+55.2                   {bergquist tim thickness (microns) vs.
     pressure (psi), k=.7 W/mK}
804  k=1.20                                 {Conductivity of TIM W/mK}
     t_m=t*convert(micron,m)
     A_in2=A*convert(m^2,in^2)              {Final Area of TIM}
813  Af=Afinal(A_lid,A)                     {Call function Afinal}
     Af_in2=Af*convert(m^2,in^2)            {Final Area of TIM converted to in^2}

814  eta=.15
                    801                     {eta = A_epsilon/A_lid}
     A_ psilon=A_lid*eta                    {Effective Area: Equivilant area for
     uniform heat flux}
815  Af2=Afinal2(A_epsilon,A)               {Call function Afinal2}
     theta=t_m/(k*Af2)                      {Thermal resistance of TIM}
```

FIG. 8

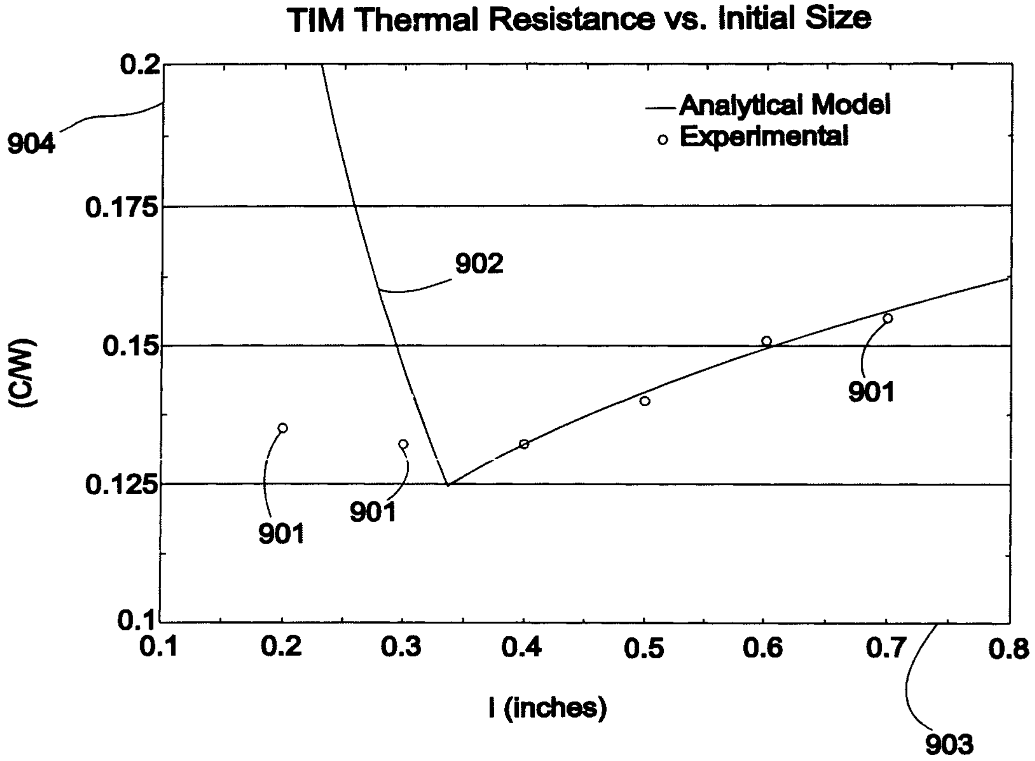
TIM Thermal Resistance vs. Initial Size
—Analytical Model
o Experimental
(C/W)
0.2
0.175
0.15
0.125
0.1
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
l (inches)
904
902
901
901
901
903

FIG. 9

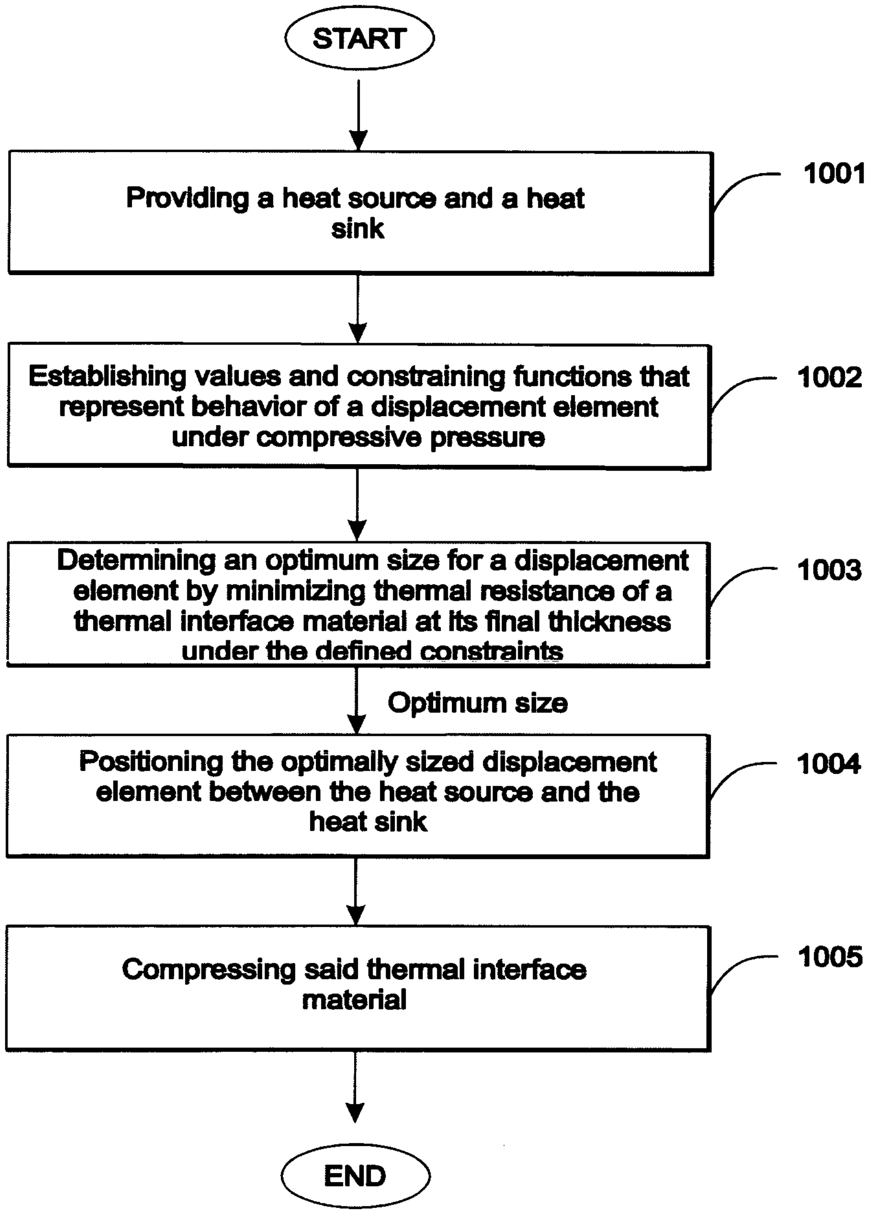
START
Providing a heat source and a heat sink
1001
Establishing values and constraining functions that represent behavior of a displacement element under compressive pressure
1002
Determining an optimum size for a displacement element by minimizing thermal resistance of a thermal interface material at its final thickness under the defined constraints
1003
Optimum size
Positioning the optimally sized displacement element between the heat source and the heat sink
1004
Compressing said thermal interface material
1005
END

FIG. 10